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MODELING AND ASSESSMENT OF THE IMPACT OF MONETARY POLICY INSTRUMENTS ON THE ECONOMIC GROWTH OF KAZAKHSTAN

Abstract. The article simulates and assesses the impact of monetary policy instruments on macroeconomic indicators of Kazakhstan's development. It has been established that there is almost complete agreement on the long-term relationships between money supply, inflation and GDP, exports and imports.

Based on the results of the research, we recommend in practice to use a monetary policy option, on the one hand, with a relatively strong reaction to inflation, ensuring price stability (limiting price growth), and, on the other hand, gradually easing monetary policy to expand monetary a proposal aimed at supporting economic growth and expanding production and stimulating the development of trade.

An econometric model for assessing the impact of monetary policy on economic growth and international trade has been developed, which makes it possible to forecast the development of economic growth, exports and imports through the regulation of monetary policy instruments.

Keywords: monetary policy, economic growth, real sector of the economy, econometric model

For many years, the implementation of the monetary policy (MP) was limited to providing price stability. But the growth of periodic crises and international experience in preventing its consequences. To achieve those goal, it is necessary to strengthen the participation of credit institutions in the development of individual economic entities through their long-term lending.

For this reason in order to carry out an effective monetary policy, it is necessary to apply instruments of influence on economic activity correctly and in time taking into account temporary lags.

There are many empirical studies of monetary policy of Kazakhstan in different periods that used different methods and approaches which received different and sometimes contradictory results [1-4].

Stable function of money demand forms the basis of monetary policy management and allows changes in the monetary aggregates for the predictable impact on production, interest rates and price level.

Tools used to assess the effect of monetary policy was created with the development of time-series econometrics, and as improvement of theoretical models. One of the main tasks of this work is to determine of shifts in monetary policy and their important role in economic fluctuations.

Significant progress in understanding the empirics of the impact of monetary policy on real economic activity was achieved using the vector autoregression (VAR) approach. Sims (1972, 1980) . The first who used the VAR to assess the impact of money on the economy.

In our work, cointegration[1] quality of GDP and monetary demand in Kazakhstan was studied using the cointegration method, vector autoregression (VAR, DVAR) and vector error correction (VECM) model with official annual data.

For more significant econometric studies of the impact of monetary policy instruments on economic growth, as well as on exports and imports, considering some of the results of previous studies. The authors of this paper considered the influence of the following independent variables (regressors): the level of inflation, the amount of money supply (M2) , r - interest rate, E - exchange rate, π - inflation level and e - error value. The dependent variable uses GDP (Y), Export (E), and Import (I).

In conducting monetary policy money demand is an important element. This fact is of additional importance in Kazakhstan where the introduction of changes in fiscal policy is limited due to the dependence of government spending on tax revenue from the oil industry.

It is generally accepted in the economy to take as the basis of the model the function of money demand of the following kind:

$$\frac{M}{P} = f(Y, R), \tag{1}$$

where M - monetary aggregate in nominal form, P - price, R -interest rate.

Money demand is directly related to the production whereas inversely proportional to interest rates. According to Friedman (1987), this function can expand and include several key variables. As a result, we choose the following definition for the function of money demand:

$$Y_t = \beta_0 + \beta_1 M_{2t} + \beta_2 r_t + \beta_3 E_t + \beta_4 \pi_t + et, \tag{2}$$

where Y- yield, M2 -monetary aggregate, r -interest rate, E - exchange rate, π - inflation rate, and e - margin of error.

The choice of indicators is related to the fact that modern economists there is no consensus on the causes of inflation and forecast of its development, in connection with a different assessment of the role of monetary and non-monetary factors of inflation. As a result, we examined the inflation and money supply indicators their interrelationships as well as the impact on the dynamics of GDP change. The impact of exports and imports on the dynamics of GDP changes was also analyzed.

To estimate the model, we used annual data from 1993 until 2015. The data were retrived from the website of the National Bank of the Republic of Kazakhstan and the website of the CIS Statistical Committee [5].

Methodology and evaluation

In this study, the method used by the integration model of vector autoregression (VAR, DVAR) and vector error correction model (VECM) to study the long-term cointegration relation between the money supply and its determinants. This application requires time series testing for stationarity. If time series are stationary at a level, then regression by the least squares method could be used. However, if the series are not stationary by the order of zero, then we check the first difference and check for stationarity.

The data obtained are GDP not adjust for seasonal variations. To eliminate seasonality, we use the methodology X-11 ARIMA and get smoothed data (Figure 1).

Use the extended Dickey-Fuller test (ADF) to check for stationarity. The results are shown in Tables 1 and 2.

[1] Cointegration is a property of several non-stationary (integrated) time series, consisting in the existence of some of their stationary linear combinations.

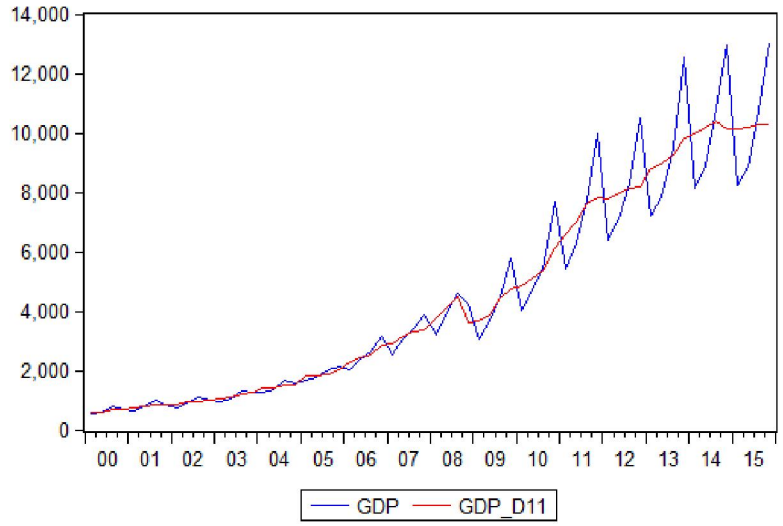

Figure 1 - GDP and adjusted GDP of the Republic of Kazakhstan

Make use of the extended Dickey-Fuller test (ADF) to check for stationarity. The results are shown in Tables 1-3.

Table 1 - The stationarity test for logarithmic time series I (0)

	t-Statistics	probability
gdp_log	-5.14327	0.0005
m2_log	-3.60799	0.0142
exchange_log	-10.4613	0.0000
ir_log	-6.71674	0.0000

Table 2 - The stationarity test of time series is of the order of zero

	t-Statistics	probability
gdp	2.8464	1.0000
m2	0.1127	0.9589
export	-0.6453	0.8407
import	1.3734	0.9979
exchange	-0.4651	0.8799

Table 3 - The stationarity test of time series of the first difference

	t-Statistics	probability
gdp	0.4606	0.9795
m2	-2.4453	0.1423
export	-4.1335	0.0047***
import	-1.5846	0.4696
exchange	-2.4352	0.1448

where m2- monetary aggregate; gdp_d11 - GDP; exchange - exchange rate; cpi - price level, ir - interest rate; export - export; import-import; *** - statistically significant by 1%.

The results of the ADF test (Table 1) for logarithmic time series show that the logarithmic GDP, m2, exchange rate and interest rates are stationary at 5% level. These variables can be used in the VAR model.

The ADF test results (Tables 2 and 3) show that there are no stationary variables at the zero level. When testing the first difference we get stationary variables as export. Export is statistically significant at

1% level. Since these variables are stationary at different levels as I (1) and below, we can estimate the long-term relationship between them using the cointegration method.

Estimating GDP using the VAR model

Using the logarithmic values of the variables gdp, m2, ir and exchange, create a VAR model where the GDP will be dependent, the money amount (m2), the exchange rate and the interest rate (ir) - independent (Table 4).

Table 4 - Model VAR for GDP of the Republic of Kazakhstan

Dependent Variable: LOG(GDP)
Method: Least Squares
Date: 06/05/17 Time: 17:31
Sample (adjusted): 1995 2016
Included observations: 21 after adjustments
LOG(GDP) = C(1)*LOG(GDP(-1)) + C(2)*LOG(GDP(-2)) + C(3)*LOG(M2(-1)) + C(4)*LOG(M2(-2)) + C(5)*LOG(IR(-1)) + C(6)*LOG(IR(-2)) + C(7) *LOG(EXCHANGE(-1)) + C(8)*LOG(EXCHANGE(-2)) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.660511	0.157136	4.203423	0.0012
C(2)	-0.232627	0.102095	-2.278540	0.0418
C(3)	0.210813	0.090944	2.318049	0.0389
C(4)	0.154188	0.125556	1.228039	0.2430
C(5)	-0.255508	0.131901	-1.937121	0.0766
C(6)	0.079540	0.062708	1.268415	0.2287
C(7)	0.316972	0.132022	2.400910	0.0335
C(8)	-0.315517	0.136942	-2.304022	0.0399
C(9)	3.026065	0.956428	3.163924	0.0082
R-squared	0.998698	Mean dependent var		8.925327
Adjusted R-squared	0.997830	S.D. dependent var		1.235925
S.E. of regression	0.057567	Akaike info criterion		-2.574214
Sum squared resid	0.039767	Schwarz criterion		-2.126562
Log likelihood	36.02925	Hannan-Quinn criter.		-2.477062
F-statistic	1150.839	Durbin-Watson stat		2.177496
Prob(F-statistic)	0.000000			

Table 4 shows the result of the vector autoregression model where GDP with log values is a dependent variable. This equation is as follows:

LOG(GDP) = 0.66*LOG(GDP(-1)) - 0.23*LOG(GDP(-2)) + 0.21*LOG(M2(-1)) + 0.15*LOG(M2(-2)) - 0.26*LOG(IR(-1)) + 0.08*LOG(IR(-2)) + 0.32*LOG(EXCHANGE(-1)) - 0.32*LOG(EXCHANGE(-2)) + 3.03

GDP of the past two years are statistically significant at 5% level. The GDP increase of the past year by 1% what raises the GDP of the current by 0.66%, and 1% of the GDP of the penultimate year affects negatively the current by 0.23%. The money supply with lag 1 is statistically significant by 5% with a coefficient of 0.21, which changes the GDP by 0.21% when the money supply of the past year changes by 1%. M2 with lag 2 is not statistically significant.The interest rate coefficient of the past year is statistically significant only at the 10% level. An increase in the interest rate implies a decrease in GDP by 0.25%. IR with a lag of 2 years is not statistically significant. The exchange rate coefficients are significant at 5% level and are equal to 0.32% and -0.32%. Lowering the tenge's rate against the dollar by 1% leads to an increase in GDP by 0.32%.Free coefficient with a value of 3.03 is also statistically significant. If M2 interest rate and KZT exchange rate do not change the GDP of the country increases by 3.03%. The coefficient of determination is 99.9%. They are the change in past GDP, M2, the exchange rate and the

base interest rate explains the change in GDP by 99 percent. In this equation there is no autocorrelation, and the equation with high f-statistics shows the significance and reliability of the model.

Exports and imports assessment

The next step was the cointegration of time series variables to determine the long-term relationship of exports, imports and their explanatory variables. If there is indeed a cointegration link, then vector error correction can be used to identify the relationship between the model variables in the short and long terms. If not, then DVAR is used.

Further, Johansen's test for exports, money supply, tenge rate and basic interest rate was carried out.

Table 5 - Johansen's test

Date: 06/05/17 Time: 19:35
Sample (adjusted): 1995 - 2016
Included observations: 21 after adjustments
Trend assumption: Linear deterministic trend
Series: EXPORT_TG M2 EXCHANGE IR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.998064	163.1563	47.85613	0.0000
At most 1 *	0.617900	31.96236	29.79707	0.0277
At most 2	0.428199	11.75881	15.49471	0.1689
At most 3	0.000978	0.020548	3.841466	0.8859

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.998064	131.1940	27.58434	0.0000
At most 1	0.617900	20.20355	21.13162	0.0670
At most 2	0.428199	11.73826	14.26460	0.1209
At most 3	0.000978	0.020548	3.841466	0.8859

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Using trace statistics and the maximum Eigenvalue, it was discovered that there are two cointegration links between the variables at the 5% level.

Therefore, it is possible to calculate the long-term relationship between exports and short-term errors.

Based on the results of export valuation construct a model of the following type:

D(EXPORT) = -0.05*(EXPORT(-1) - 0.83*M2(-1) - 639.52*EXCHANGE(-1) - 3560.12*IR(-1) + 139622.05) - 1.24*D(EXPORT(-1)) - 0.92*D(EXPORT(-2)) + 1.7*D(M2(-1)) + 2.63*D(M2(-2)) - 69.79*D(EXCHANGE(-1)) + 18.02*D(EXCHANGE(-2)) + 78.7*D(IR(-1)) - 4.9*D(IR(-2)) + 1561.31

Analyzing the result note that the correction factor -0.05 is negative, but it is not statistically significant. The long-term effect of independent variables on exports is statistically insignificant. There is

a statistically significant short-term export link with the money supply and the exchange rate and the connection with the interest rate is insignificant.

Both interest rates are statistically insignificant. The Wald test in Table 6 shows that in fact the interest rate coefficients in the equation with exports are 0.

Table 6 - The Wald test on the coefficients ir

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.553013	(2, 10)	0.2586
Chi-square	3.106026	2	0.2116

Null Hypothesis: C(8) = C(9) = 0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	78.69917	44.76264
C(9)	-4.897230	5.683620

Restrictions are linear in coefficients.

Further, exclude the variable ir from the export equation. The cointegration test finds no cointegration between exports: M2 and the exchange rate. In this case, the VECM model is not suitable. The DVAR model for export m2 and currency rate is used.

Table 7 - Equation of export in the DVAR model

Dependent Variable: D(EXPORT_TG)
Method: Least Squares
Date: 06/02/17 Time: 18:20
Sample (adjusted): 1996 2016
Included observations: 20 after adjustments
D(EXPORT) = C(1)*D(EXPORT(-1)) + C(2)*D(EXPORT(-2)) +
C(3)*D(M2(-1)) + C(4)*D(M2(-2)) + C(5)*D(EXCHANGE(-1)) + C(6)
*D(EXCHANGE(-2)) + C(7)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.131594	0.229274	-4.935552	0.0003
C(2)	-0.927230	0.278925	-3.324303	0.0055
C(3)	2.052360	0.628120	3.267464	0.0061
C(4)	1.859157	0.799696	2.324830	0.0369
C(5)	-20.79592	18.83926	-1.103861	0.2897
C(6)	9.083026	18.34342	0.495165	0.6287
C(7)	351.0478	409.5227	0.857212	0.4069

R-squared	0.765056	Mean dependent var	490.9369
Adjusted R-squared	0.656620	S.D. dependent var	1609.746
S.E. of regression	943.2891	Akaike info criterion	16.80584
Sum squared resid	11567325	Schwarz criterion	17.15435
Log likelihood	-161.0584	Hannan-Quinn criter.	16.87387
F-statistic	7.055383	Durbin-Watson stat	1.998232
Prob(F-statistic)	0.001650		

The result of the DVAR model with the dependent export variable is shown in Table 7. The coefficients of changes in exports and the money supply of the past years are statistically significant.

Increasing in the money supply by 1 billion tenge would increase exports by 2.05 billion tenge in a year and 1.86 billion tenge in two years.

The currency rate in this model is not statistically significant.

There is no autocorrelation in this equation. The coefficient of determination is high - at the level of 76.5%. The change in exports, the money supply and the tenge exchange rate for the past 2 years are explained by a 76.5% change in exports in this year. F statistic is 7.05 - means the significance and reliability of the model.

Similarly, assessing imports with independent variables like m2, exchange and ir, we get a statistically insignificant correction factor and the interest rate is also not significant. The test of Wald confirms that the interest rate coefficients are 0.

Remaining variables are not integrated and also allow the construction of the DVAR model.

Table 8 - Import estimation model DVAR of the Republic Kazakhstan

Dependent Variable: D(IMPORT)
Method: Least Squares
Date: 06/05/17 Time: 22:11
Sample (adjusted): 1996 2016
Included observations: 20 after adjustments
D(IMPORT) = C(1)*D(IMPORT(-1)) + C(2)*D(IMPORT(-2)) +
C(3)*D(M2(-1)) + C(4)*D(M2(-2)) + C(5)*D(EXCHANGE(-1)) + C(6)
*D(EXCHANGE(-2)) + C(7)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.331261	0.273020	1.213319	0.2466
C(2)	-0.570260	0.234888	-2.427798	0.0305
C(3)	0.516101	0.212720	2.426194	0.0305
C(4)	0.047095	0.280461	0.167920	0.8692
C(5)	-0.171864	7.189835	-0.023904	0.9813
C(6)	-6.151452	6.447297	-0.954113	0.3574
C(7)	235.4591	167.4934	1.405782	0.1832

R-squared	0.701103	Mean dependent var	323.0562
Adjusted R-squared	0.563150	S.D. dependent var	485.6583
S.E. of regression	320.9940	Akaike info criterion	14.64994
Sum squared resid	1339483.	Schwarz criterion	14.99845
Log likelihood	-139.4994	Hannan-Quinn criter.	14.71797
F-statistic	5.082201	Durbin-Watson stat	2.407377
Prob(F-statistic)	0.006837		

In table 8 DVAR model is constructed for import with two lags. The impact of the money supply after one year is statistically significant. Increasing in the money supply by KZT 1 billion (other things being equal) would increase import by 0.52 billion tenge in a year. After two years the effect of m2 is not significant. The exchange rate coefficient is also not significant. Autocorrelation of the remainders is not noticed at the 5% level. F statistics is 5.08 - the model is reliable and meaningful.

Conclusion

Monetary policy influences the real sector of the economy ways confirmed that there are statistically significant stable relationships between the changes in monetary policy instruments and the dynamics of real variables.

This search analyzes the cointegration quality of Kazakhstan's monetary demand, using annual data between 1993 and 2015 the vector autocorrelation method (VAR, DVAR), and the vector error correction model (VECM).

There are almost complete agreement on the long-term relationships between money supply, inflation and GDP. The growth of money supply and inflation shows a correlation close to 1. Correlation between money supply growth inflation and GDP is close to 0. Although it may be weakly positive at low inflation rates and slightly negative at high rates.

The results of the research showed that an increase in the money supply by one percent leads to an increase in GDP by 0.21%. Interest rate in the models with exports and imports is not statistically significant. The increase in the money supply by 1 billion tenge leads to an increase in exports by 2.05 billion tenge in a year and in another hand by 0.52 billion tenge in imports in a year.

The results also lead to the opinion of the relatively short-term effects of the money supply. When exposure is achieved after two or three years, and then the effect subsides.

Increasing in the money supply by 1 billion tenge would increase exports by 2.05 billion tenge in a year and by 1.86 billion tenge in two years.

Increasing money supply by KZT 1 billion (other things being equal) would increase import by 0.52 billion tenge in a year. After two years, the effect of *m2* is not significant.

In practice recommended to use monetary policy, on the one hand, with a relatively strong reaction to inflation, ensuring price stability (limiting price growth), and on the other hand, to gradually soften the monetary policy in order to expand the money supply aimed at supporting economic growth and expanding production and stimulating trade.

One of the most important ways, from our point of view, of increasing the effectiveness of the monetary policy is the proper choice of priorities (goals). An important direction for increasing the efficiency of the monetary policy (increasing the monetization of the economy, intensifying investment activities, stimulating economic growth, etc.). In our opinion seems to be an improvement in its relationship with fiscal policy.

In the medium term phased introduction should be introduced of a new transmission mechanism.

Kazakhstan has become a full-fledged subject of globalization, taking into account the latter's influence on monetary policy and the economy as a whole altrough:1) structural reforms (there are changing the structure of domestic and external demand; reducing the need for imported goods; organizing events to support exporters); 2) attracting investments, primarily to the banking sector, through tax incentives and various guarantees for foreign investors; 3) development of the savings system of the population (if we focus only on attracting foreign investment, external debt will continue to grow); 4) development of financial and stock markets using the active role of banks; 5) use of financial policy tools to regulate problems in the financial market.

Implementation of the above recommendations can contribute to the development of the economy increase its sustainability as well as economic growth.

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АҚША-КРЕДИТ САЯСАТЫНЫҢ ҚҰРАЛДАРЫН ҚАЗАҚСТАН ЭКОНОМИКАСЫНЫҢ ӨСУІНЕ ӘСЕР ЕТУІН МОДЕЛЬДЕУ ЖӘНЕ БАҒАЛАУ

Аннотация. Мақалада ақша-кредит саясатының құралдарын Қазақстанның дамуының макроэкономикалық көрсеткіштеріне әсер етуін моделдеу мен бағалау арқылы жүргізілген. Зерттеу барысында ақша, инфляция, ЖІӨ, экспорт және импорт арасындағы ұзақ мерзімді қарым-қатынас туралы толық дерлік келісім бар екенін анықталды.

Зерттеу нәтижелері бойынша тәжірибеде ақша-кредит саясатының нұсқасын пайдалану тәжірибесі ұсынылады, бір жағынан – инфляцияға деген күшті реакциясы бар бағаны тұрақты қамтамасыз ететін (бағалардың өсу шектеу), ал екінші жағынан – экономикалық өсу мен өндірісті қолдайтын және сауданы ынталандыруға бағышталған ақша-кредит саясатын біртіндеп жұмсартуды жүзеге асыру.

Ақша-кредит саясатының құралдарын реттеу арқылы экономикалық өсу, экспорт пен импорттың дамуын болжауға мүмкіндік беретін, экономикалық өсу және халықаралық сауда бойынша ақша-кредит саясатының әсерін бағалау үшін эконометрикалық моделі әзірленді.

Түйін сөздер*:* ақша-кредит саясаты, экономикалық өсу, экономиканың нақты секторы, эконометриялық модель

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МОДЕЛИРОВАНИЕ И ОЦЕНКА ВЛИЯНИЯ ИНСТРУМЕНТОВ ДЕНЕЖНО-КРЕДИТНОЙ ПОЛИТИКИ НА ЭКОНОМИЧЕСКИЙ РОСТ КАЗАХСТАНА

Аннотация. В статье проводятся моделирование и оценка влияния инструментов денежно-кредитной политики на макроэкономические показатели развития Казахстана. Установлено, что наблюдается почти полное согласие по поводу долгосрочных взаимосвязей между денежной массой, инфляцией и ВВП, экспортом и импортом.

Исходя из результатов исследований, рекомендуется использовать на практике вариант денежно-кредитной политики, с одной стороны - с относительно сильной реакцией на инфляцию с обеспечением ценовой стабильности (ограничением роста цен), а с другой – осуществлять постепенное смягчение денежно-кредитной политики в целях расширения денежного предложения, направленного на поддержание экономического роста и расширение производства и стимулирование развития торговли.

Разработана эконометрическая модель оценки влияния денежно-кредитной политики на экономический рост и международную торговлю, позволяющая составить прогноз развития экономического роста, экспорта и импорта посредством регулирования инструментов денежно-кредитной политики.

Ключевые слова: денежно-кредитная политика, экономический рост, реальный сектор экономики, эконометрическая модель.